

## RIVERS AND FLOODS

[River and Flood Division, MERRILL BERNARD in Charge]

By THOMAS S. SOUTHWICK

Precipitation was abundant during February and March, being well above normal in the central and eastern portions of the country. Floods were numerous in the eastern United States, but fortunately, the flood-producing rains were well distributed throughout this period so that these floods were, in general, characterized by long duration rather than by severity. The total damage reported from floods during February and March amounted to \$1,462,535. Detailed damage figures are given in the table at the end of this article. The breaking up of ice and melting of the snow cover contributed to the floods of this period in the Northern States.

*St. Lawrence drainage.*—High temperatures, with attendant moderate precipitation on the 18th and 19th of February caused the ice to break up in the rivers with resulting ice jams. In the Grand River system of Michigan flood stages were reached at several points. The ice conditions at Portland, Mich., were the most severe since 1920 and gave rise to a stage of 14.0 feet, or 2 feet above flood stage. The highest previous stage was 15.2 feet in 1920. Damage was confined mostly to flooding of basements.

The Maumee River system experienced a small flood of short duration resulting from moderate precipitation on February 19 and 20. There was a snow cover in the St. Joseph River Basin which, melting under the high temperatures accompanying this rain, caused flood stages to be attained. The rise on the St. Marys River was slight, so that flood stage was not reached on the Maumee below Fort Wayne. No damage was reported.

Another rise occurred on the Maumee as the result of heavy rains on the night of March 11–12. While there was not the snow cover that contributed to the February flood, and the rains were not excessive, stages were already high, and the rivers rapidly rose above flood stage. While this flood was of minor importance, some inconvenience resulted from flooding of roads.

*Atlantic Slope drainage.*—Abnormally high temperatures prevailed over the eastern portion of the country during the period February 18–20. These temperatures which ranged into the 50's and 60's, together with rains of about half an inch or more falling on a snow cover of 2 to 2½ inches of water content, gave rise to rapid run-off in the rivers of the Northeastern States. In New York and in the Susquehanna watershed, where conditions were most propitious, flooding of moderate proportions took place. The ice in the northeastern rivers went out during this period of high temperatures and some ice jams resulted. Moderate damage was reported from this rise and two lives were lost when ice swept away a ramp at Elmira, N. Y.

These rivers remained at high levels so that only light to moderate rains on March 6 and 7 sufficed to raise stages to flood stage or slightly above. High temperatures on March 25 and 26 added an increment of melted snow to moderate rain, and streams in this region were generally above flood stage sometime between March 26 and 30.

The rivers of New England remained at low stages during this period. At the close of March, there remained a considerable snow mantle on the ground which constituted a potential flood hazard as the warm season approached.

In the South Atlantic States floods were prevalent throughout February and March with February having

the greatest number. Rainfall along the Atlantic Seaboard ranged from one and one-half to two times that of normal during February, while March experienced about normal rainfall. This rain was the result of numerous frontal systems which invaded the Southeastern States in addition to considerable cyclonic development along the coast. Consequently, while rainfall was heavy and frequent, the areas of high intensities were generally small in area for each storm, and there are few well-defined flood periods. Most of the rivers passed flood stage several times during this period. At some stations flood stages continued for over a month, notably on the Neuse, Pee Dee, Santee, and Savannah Rivers where the frequent rains did not permit the rivers to recede below flood stage before the advent of another flood period. While stages were high at some stations, they were far from being excessive, although considerable damage was reported on some rivers.

*East Gulf of Mexico drainage.*—The rainfall distribution during February and March was similar to that prevailing in the Atlantic coast region. The precipitation for February at Meridian, Miss., was the fourth highest monthly total in 50 years of record. The Pearl, Tombigbee, and Black Warrior Rivers were at high stages from the rises of January, and the abundant rainfall in February maintained these rivers above flood stage from early in February into March for periods of over a month. While stages slightly above flood stage were reached on some of the other rivers in early February, the outstanding flood situation and highest crest stages resulted from heavy rains during the period February 25–28.

March experienced less precipitation than February, but there were locally heavy storms throughout the month, and on March 29–30 a disturbance from the Gulf resulted in heavy rainfall over the area. Several stations reported 24-hour amounts of over 3½ inches. Stages on the Tombigbee and Pearl were prolonged above flood stage into April, and on the other rivers of the region stages were rising at the close of March.

On most of the rivers in this area stages reached were moderate, causing nominal damage.

*Upper Mississippi Basin.*—February precipitation was about normal over the basin, but much of it was in the form of snow. The only flood stages attained in February were on the Illinois River at Peru, Ill., on the 12th due to moderate rain, and again on the Illinois at Havana and below, and on the Rock River in the latter part of the month when mild weather caused some ice breakup. In these instances flood stages were but slightly exceeded.

The Mississippi River system above La Crosse, Wis., experienced flood conditions in March which were due almost entirely to run-off from melting snow. Precipitation was decidedly below normal, but with a heavy snow cover on the ground and mild temperatures prevailing during the month, run-off was high with ice breaking up in the rivers. Moderate flood stages were reached in the latter part of the month with the crest in the main channel of the Mississippi reaching La Crosse about midnight of April 1–2. Most of the damage resulting was to highways.

In the lower drainages, the streams had receded but little from the rises due to the mild weather in February when heavy rains occurred on March 11 and 12. Storm totals of over 3 inches were reported at several stations. Moderate flood stages were general over the basin except

in the extreme northern portion in Wisconsin and Minnesota which received no precipitation during this period.

The damage was only nominal as crops had not as yet been planted. In fact, the deposit of new soil was reported to be beneficial.

**Missouri Basin.**—There were no floods in the Missouri Basin in February. In March, the heavy rains of the storm of March 11–12 resulted in the Grand River going above flood stage. The flooding was not extensive or damaging. On the Missouri River unusually warm weather caused much snow to melt. Considerable flooding resulted in the headwaters, and at lower levels ice gorges formed with local floods at Bismarck, N. Dak., and Nebraska City, Nebr. The stages at these latter stations were not extreme. Of the rise in the headwaters of the river, the following description is given by the official in charge, Helena, Mont.:

Sudden melting of what remained of winter's accumulation of snow and ice on the lower levels combined with the frozen condition of the ground that prevented absorption of the snow water caused freshets and floods in northern streams and rivers during the week beginning March 18. Ice gorges were responsible for some of the flood conditions. Principal flooded areas were along the Milk and extreme lower Yellowstone Rivers, and the Big Muddy, Porcupine, and Poplar Creeks. The Milk River was reported in flood from Lohman in western Blaine County to Nashua in eastern Valley County. Numerous homes were evacuated in Malta, Chinook, Hinsdale, Saco, and in farming communities scattered throughout the flooded area.

The flood waters of the Milk River and its tributaries, and other streams, washed out bridges, railroad and highway grades, and interrupted rail and highway traffic for 2 to several days.

Considerable loss of livestock was reported, particularly sheep. There was much damage to farm and town buildings and related property. Flood waters of the Milk River were considered the greatest since 1917 in the affected area. In the Big Muddy section the spring run-off was reported the greatest in history.

**Ohio Basin.**—The outstanding flood of this period was that of the Ohio River drainage. The flood was not unduly severe, but its long duration, especially in the lower reaches throughout the wet weeks of February and March, and with memories of the great flood of 1937 still fresh in the minds of residents, it caused great apprehension. This was, however, of benefit, as people evacuated their homes, and property and stock were removed in ample time so that the damage was less in proportion to the stages reached than in most other Ohio floods.

As compared with the 1937 flood, the period of wet weather was longer, the total amounts of precipitation less and the rises in the tributaries more favorably timed. As a result, stages were not disastrously high except in the headwaters of a few of the southern tributaries of the Ohio River where new records were established.

The Ohio flood had its inception in the last 3 days of January when a general storm gave rains of about 2 inches over the entire basin, followed by another storm on February 2–3 which was centered over the upper Ohio River and the Kentucky and Cumberland headwaters. Rainfall depths varied from 2 inches over the Pittsburgh area to 4 and 5 inches over the upper Cumberland watershed. On February 3 warnings were issued for all stations on the Ohio River and most of its southern tributaries.

Rains were quite well distributed from the beginning of February until the middle of March, but there were two well-defined storm periods which resulted in two crests on much of the Ohio River. The first storm was the one of February 3–4, and the second occurred on March 4 and 5.

With the exception of the White and Wabash Rivers, serious flooding did not occur in the tributaries to the north of the Ohio River. Part of the precipitation over these northern tributaries during February was in the

form of snow which served to delay the period of run-off with resulting lower crests.

The rainfall amounts at a number of stations for this flood and for the great flood of January–February 1937 are listed below:

	Dec. 26– Jan. 25 1937	Jan. 30– Mar. 15, 1939
Pittsburgh, Pa.	7.03	7.06
Parkersburg, W. Va.	9.56	10.03
Cincinnati, Ohio	15.21	10.30
Evansville, Ind.	15.42	12.64
Nashville, Tenn.	15.53	12.22
Indianapolis, Ind.	10.28	8.14

In western Pennsylvania and West Virginia there was a considerable snow cover in the mountains which contributed to the run-off from the first February storm. Considering this added increment of snow run-off, the precipitation in the headwaters of the Ohio Basin was greater than in 1937, and higher stages resulted than in 1937 on the Tygart, Youghiogheny, Monongahela, Walhonding, Little Kanawha, Elk, Guyandot, Twelve Pole Creek, Big Sandy and its tributaries, Little Sandy, and the Kentucky River down to lock No. 10. On the Cumberland River, Williamsburg, Ky., and Burnside, Ky., exceeded their 1937 crests, as did stages on the Hiwassee River at Charleston, Tenn., and on the Tennessee River at Florence, Ala., and Savannah, Tenn.

From this it can be seen that the major source of the Ohio flood was in the southern and eastern headwaters. Of the tributaries to the north, only the Scioto River at La Rue, Ohio, had a stage greater than in 1937. However, the flood stages on this river occurred in the middle of March and reached the Ohio River when its height was well below flood stage.

In addition to the general storms which covered the entire basin with generous precipitation, there were others which embraced only a portion of the area. This was especially true in the southern part of the Ohio River Basin where a number of disturbances gave heavy precipitation over the Cumberland and Tennessee River drainages. On the night of March 11–12 heavy rains up to 3 inches depth fell over the White, Wabash, and Scioto River Basins. The maximum crests of the different rises occurred after this storm.

In the lower reaches of the Ohio River, the flood was distinguished by its long duration above flood stage. A comparison at a few selected stations of the number of days above flood stage in this flood and in the 1937 flood are given:

	1939	1937
Pittsburgh, Pa.	1	10
Cincinnati, Ohio	5	19
Louisville, Ky.	7	23
Dam No. 44, Leavenworth, Ind.	15	25
Evansville, Ind.	48	41
Paducah, Ky.	47	44
Cairo, Ill.	50	50

#### DISTRICT REPORTS

##### OHIO RIVER AND TRIBUTARIES AT AND ABOVE DAM NO. 13

By W. S. BROTZMAN

Rain set in over practically the entire Pittsburgh district during the early morning of February 2, and continued until the afternoon of the 3d. The amounts of rainfall reported on the morning of the 2d were light, but by the morning of the 3d there was an average